

Lightweight, Reliable Cryogenic Screen Channel Acquisition Devices with High Expulsion Efficiency, Phase I

Completed Technology Project (2018 - 2019)



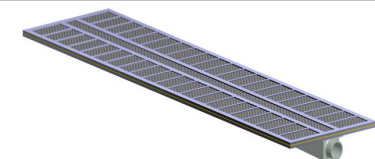
Project Introduction

Refueling spacecraft in space offers tremendous benefits for increased spacecraft payload capacity and reduced launch cost. However, in a microgravity environment, acquiring vapor-free cryogenic liquid propellants from supply tanks and then transferring them to receiving tanks of a rocket engine is very challenging. To address this challenge, we propose to develop a robust, lightweight cryogenic screen channel Liquid Acquisition Device (LAD) with a novel configuration that is assembled by Creare's unique fabrication processes to reliably maintain the pore structure of the screen near its bonding joints with its support frames. Creare's configuration also provides mechanical support for the screen to withstand launch vibrations. The novel configuration significantly increases the screen area compared to existing screen channels for the same size and mass. Creare's LAD also significantly reduces the liquid holdup inside the screen channel. These features together significantly increase the expulsion efficiency of the LAD. In Phase I, we will demonstrate the feasibility of our approach through designing, fabricating, and testing a proof-of-concept screen channel at cryogenic temperature. In Phase II, we will build and demonstrate a laboratory-scale liquid acquisition device and deliver it to a NASA research lab for further evaluation.

Anticipated Benefits

The proposed screen channel technology will enable reliable spacecraft refueling in a microgravity environment. The resulting lightweight LAD will enable reliable cryogenic propellant transfer at high expulsion efficiency, and thus reduce cost of space missions. The technology also has applications as phase separators in two-phase bio and chemical reactors, as well as in fluid management for two-phase flow thermal management and power systems.

The technology developed in this project has applications in propellant acquisition systems in commercial spacecraft, and gravity-insensitive aircraft fuel supply systems. The capillary structure fabrication technology developed in this program will also have many applications in terrestrial two-phase thermal management systems.



Lightweight Screen Channel Acquisition Devices Assembled by Novel Fabrication Processes for Reliable Cryogenic Operation

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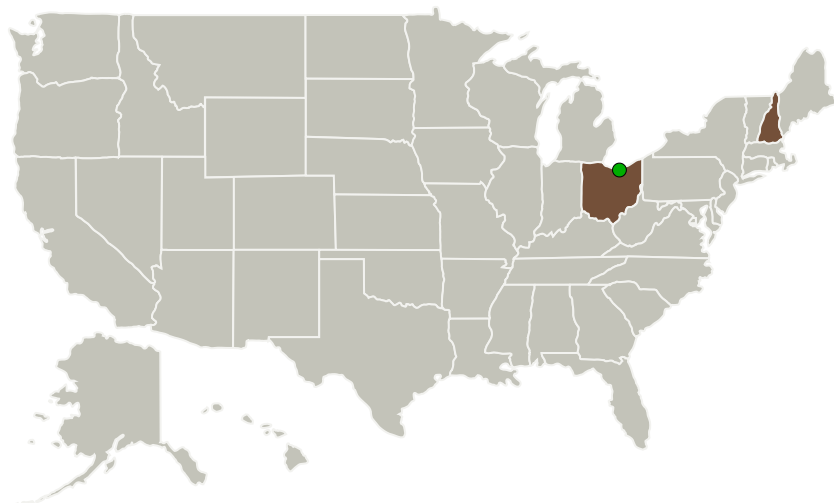
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

New Hampshire	Ohio
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Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/141150>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Weibo Chen

Co-Investigator:

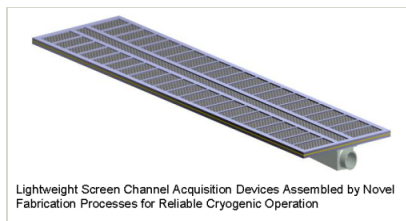
Weibo Chen

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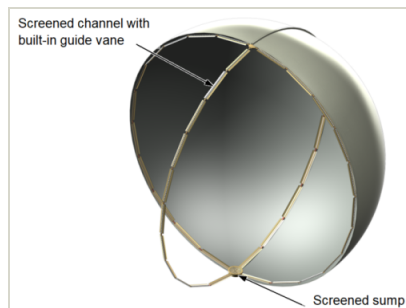
Images



Briefing Chart Image

Lightweight, Reliable Cryogenic Screen Channel Acquisition Devices with High Expulsion Efficiency, Phase I

(<https://techport.nasa.gov/image/136509>)



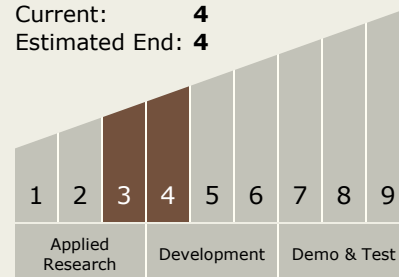
Final Summary Chart Image

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(<https://techport.nasa.gov/image/136800>)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.1 Integrated Systems and Ancillary Technologies

Target Destinations

Earth, The Moon, Mars